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Determinants and consequences of abnormal visual
cortex responsiveness in migraine without aura

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Thèse présentée en vue de l'obtention du grade de
DOCTEUR EN SCIENCES MEDICALES



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Summary

Migraine is a complex multifactorial disease that arises from the interaction between a genetic predisposition and an enabling environment. The greatest amount of sensory information we receive from our surroundings reaches us via the visual system, making vision the most developed sense in humans, and the one that engages the largest areas of the human brain.

Cumulative clinical and experimental evidence has shown that migraine patients are hyper-responsive to visual stimulus, yet the determinants of this phenomenon are poorly understood. Furthermore, though closely associated with migraine, visual hyper-responsiveness is not sufficient, nor necessary, to develop the disorder, suggesting that additional pathophysiological mechanisms must play a role.

The purpose of this thesis was to analyse the environmental, anatomofunctional, metabolic, and neurochemical factors associated with visual responsiveness in migraine patients and the implication of their interaction in the pathogenesis of the disease. We performed therefore a series of neurophysiological and neuroimaging studies that address distinct aspects of cerebral physiology.

The results show that (1) between-subject variability of visual responsiveness in migraine patients can be partially accounted for by environmental influences; (2) visual hyper-responsiveness in migraine is the result of a complex imbalance between mechanisms favouring

enhanced perception and others protecting against sensory overload; and (3) energy supplies available at the cortical level do not match the increased demands generated by enhanced visual responsiveness.

These findings illustrate the complexity of altered visual responsiveness in migraine, increase our understanding of its pathophysiology and set a path for novel lines of research.

Résumé

La migraine est une maladie multifactorielle complexe, qui résulte de l'interaction entre une prédisposition génétique et un environnement facilitant. La majeure partie de l'information venant de notre entourage nous atteint via le système visuel, ce qui fait de la vision la modalité sensorielle la plus développée chez l'Homme et celle qui met en jeu les aires cérébrales les plus étendues.

Un faisceau de données cliniques et expérimentales a montré que les patients migraineux sont hyper-réactifs à la stimulation visuelle, mais les déterminants de ce phénomène restent méconnus. De plus, bien qu'étroitement associée à la migraine, l'hyper-réactivité visuelle n'est ni suffisante, ni nécessaire pour développer la maladie ce qui suggère l'existence de mécanismes physiopathologiques additionnels.

Dans cette thèse nous avons analysé des facteurs environnementaux, métaboliques, anatomo-fonctionnels, et neurochimiques liés à la réactivité visuelle chez les migraineux, et la possible implication de leur interaction dans la pathogénie de la maladie. Pour ce faire, nous avons réalisé une série d'études neurophysiologiques et de neuroimagerie qui explorent des aspects distincts de la physiologie du cerveau.

Les résultats montrent que (1) une part de la variabilité inter-individuelle de la réactivité visuelle peut être expliquée par des influences environnementales; (2) l'hyper-réactivité visuelle dans la migraine est le résultat d'un déséquilibre complexe entre les méca-

nismes qui favorisent une perception renforcée, et ceux qui protègent contre une surcharge sensorielle; (3) la réserve métabolique au niveau cortical est insuffisante face à la demande énergétique accrue due à l'hyper-réactivité visuelle.

Ces résultats illustrent la complexité des mécanismes responsables de l'hyperréactivité visuelle dans la migraine, améliorent notre compréhension de la physiopathologie de cette maladie, et ouvrent la voie à des axes de recherche innovants.

Acknowledgements

This Thesis is dedicated to my beloved wife, Erica, who left everything behind to accompany me on this journey. Thank you for the sacrifices you made, and the never-ending support you gave me in turn.

I also wish to thank my friends and family in Mexico and Argentina for their strong encouragement in the distance. This Thesis is also for you.

Getting into research and getting along in Belgium would have never been possible without the help and advice of my dear friend Kevin D'Ostilio. You are half responsible for all this. Thank you very much.

I would like to express my deepest gratitude to Prof Alain Maertens for receiving me in his service and for teaching me so many things about neurophysiology.

Thanks to my promoters, Dr Magis and Prof Nisolle for granting me this wonderful opportunity.

I am also very grateful to Prof Scholtes, Prof Versijpt and Prof Ericpicum for their help, insightful comments and encouragement, and especially to Prof Gianluca Coppola, who I respect a lot, from whom I've learnt a lot, and whose timely intervention was a turning point that allowed me to pursue this doctorate.

Thanks to Pascale Gérard for her help and support, and thanks to Romain Nonis for his sympathy and for sharing his great musical taste.

Finally, a special mention of gratitude goes to Prof Jean Schoenen. Thank you for your mentorship and guidance throughout this whole process. I traversed the globe just to learn from you. It was definitively worth it.

This work was part of an international multicentre project supported by the European Union (EUROHEADPAIN FP7 602633).



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